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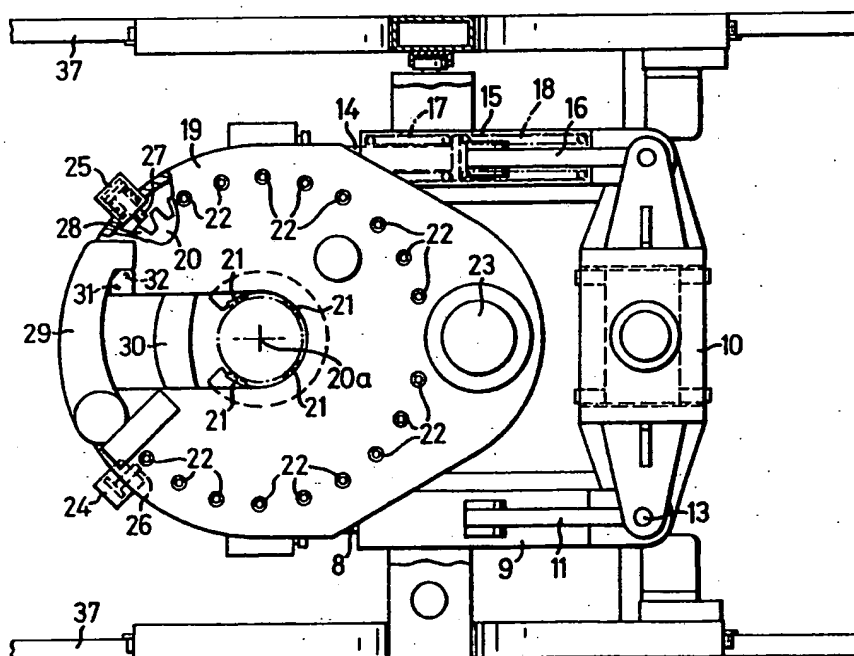
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<p>(21) International Application Number: PCT/EP92/00647 (22) International Filing Date: 23 March 1992 (23.03.92) (30) Priority data: 91 07788.3 12 April 1991 (12.04.91) GB (71) Applicants: WEATHERFORD/LAMB, INC. [US/US]; 1360 Post Oak Boulevard, Suite 1000, Houston, TX 77227 (US). LUCAS, Brian, Ronald [GB/GB]; 135 West- hall Road, Warlingham, Surrey CR6 9HJ (GB). (72) Inventor: PIETRAS, Bernd-Georg ; Sandriedeweg 12, D- 3001 Wedemark 2 (DE). (74) Agent: LUCAS, Brian, Ronald; Lucas & Co, 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European pa- tent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (Euro- pean patent), IT (European patent), LU (European pa- tent), MC (European patent), NL (European patent), NO, SE (European patent). <p>Published <i>With international search report.</i></p></p>

(54) Title: **POWER TONG FOR RELEASING TIGHT JOINTS**



(57) Abstract

If the power of a hydraulic motor (23) is insufficient to rotate a rotary (20) to start unscrewing a joint, bolts (26, 27) are advanced to inhibit relative rotation between the rotary (20) and the housing (19). Hydraulic fluid is then directed to cylinders (9, 14) to rotate the housing (19), rotary (20), jaws (21) and pipe sufficient to start unscrewing the joint.

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POWER TONG FOR RELEASING TIGHT JOINTS

This invention relates to a power tong for releasing tight joints and to a bucking unit including such a power tong.

5 Tongs are used for connecting and disconnecting threaded members. Generally, they are used in pairs, one tong (known as a "back-up tong") holding one length of pipe fast and the other tong (referred to herein as a "power tong") rotating a second length of pipe with
10 respect to the first.

The power tong conventionally comprises a rotary which has pipe gripping jaws, is rotatably mounted in a housing and can be driven in rotation by a gear train powered by an hydraulic motor.

15 Whilst the hydraulic motor is usually capable of tightening joints to the required torque problems can arise when trying to separate adjacent pipes, for example when a drill string is being withdrawn from a bore.

20 According to the present invention there is provided a power tong for releasing tight joints, which power tong comprises a housing and a rotary rotatably mounted therein, characterized in that said power tong further comprises means to inhibit relative rotation
25 between said rotary and said housing and means to pivot said housing.

Conveniently, said means to inhibit relative rotation between said rotary and said housing comprises a bolt.

30 If desired, at least two bolts may be provided.

The or each bolt may enter the rotary through the upper and/or lower surface thereof and/or through the radial extremity thereof. Alternatively, the or each bolt may be arranged to project between adjacent teeth
35 on the circumference of the rotary.

The or each bolt may be arranged to be actuated manually, or remotely.

The means to pivot the housing may be as simple as a long bar which can be placed in a slot in the housing.
5 However, the means preferably comprise a pair of cylinders connected to opposite sides of housing and actuable by pneumatic, or preferably hydraulic, fluid to pivot the housing.

Conveniently, the cylinders are double acting
10 cylinders so that the power tong can untighten clockwise and anti-clockwise threads and can also be used for applying very high tightening torques which may be required, for example for testing purposes. For this latter purpose a load cell may be provided from which
15 the torque applied to the joint can be determined.

In a preferred embodiment the double acting piston and cylinders comprise an hydraulic section and a mechanical section, and wherein said hydraulic section comprises a piston connected to an end fitting and
20 disposed in a cylinder between two ports for permitting hydraulic fluid to flow to and from said cylinder, and wherein said mechanical section comprises a piston disposed in said cylinder and connected to an opposite end fitting, said mechanical section being separated
25 from said hydraulic section by a wall.

Preferably, the power tong includes cup springs disposed to either side of said piston in said mechanical section.

The present invention also provides a bucking unit
30 comprising a back-up tong and a power tong in accordance with the invention.

For a better understanding of the invention reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a side view of a bucking unit in accordance with the invention, supported in a travelling frame which is shown in cross-section;

Figure 2 is a top plan view of the bucking unit, with part broken away; and

Figure 3 is a partially sectioned side view of an alternative double acting hydraulic piston and cylinder assembly.

Referring to the drawings, there is shown a bucking unit which is generally identified by reference numeral 1.

The bucking unit 1 comprises a back-up tong 2, and a power tong 3 which is disposed above the back-up tong 2.

The power tong 3 is supported on three balls, one of which 4, is shown in Figure 1. The ball 4 rests on a flange 5 on the side of the back-up tong 2 and is biased downwardly by a spring 6 which acts on the ball 4 through a pin 7. The power tong 3 can move upwardly away from the back-up tong 2 during an unscrewing operation.

The piston 8 of a double acting hydraulic piston and cylinder assembly is pivotally mounted on pin 7 whilst the cylinder 9 is pivotally mounted on a support member 10 projecting upwardly from the back-up tong 2. The cylinder 9 is also supported by an arm 11 which is pivotally mounted to the cylinder 9 at pivot 12 and to support member 10 about pivot 13.

As can be seen from Figure 2, the opposite side of the power tong 3 is provided with a piston and cylinder assembly which is similar to the arrangement hereinbefore described. In particular, a piston 14 is connected to a pin (not shown) associated with a spring

and ball similar to spring 6 and ball 4. The piston 14 enters the cylinder 15 of a double acting piston and cylinder assembly which is pivotally mounted on support member 10 and supported by an arm 16 similar to arm 11.

5 It will be appreciated that the arrangement disclosed allows the power tong 3 to move along the x, y and z axis. In normal use the cylinders 9 and 15 will be open to atmosphere and springs 17 and 18 are preferably provided to bias the power tong 3 towards its normal
10 operating position.

 The power tong 3 comprises a housing 19 which houses a rotary 20 which is rotatably mounted in housing 19. The rotary 20 is provided with jaws 21 which can be moved radially towards the centre of the power tong 3.
15 The rotary 20 is guided by a plurality of rollers which are mounted on axles 22 disposed circumjacent the centre of the power tong 3.

 The rotary 20 is connected by a gear train (not shown) to an hydraulic motor 23.

20 Two actuators 24 and 25 are mounted on the housing 19 and can be actuated to thrust bolts 26, 27 between the drive teeth 28 provided around the circumference of the rotary 20.

 The whole backing unit 1 is supported in a
25 travelling frame 26 which runs on rails 27.

 In use, when it is desired to disconnect a joint the doors 29 and 30 on the power tong 3 and the back-up tong 2 respectively are opened. The travelling frame 26 is then advanced towards the pipe until the pipe enters
30 the power tong 3 and the back-up tong 2. The doors 29 and 30 are then closed and the pipes gripped by the jaws in the respective tongs 2, 3.

 Hydraulic motor 23 is then actuated. Normally this will be sufficient to unscrew the joint. However,
35 situations do arise where the joint will not separate

and the hydraulic fluid intended for the hydraulic motor 23 is returned to the reservoir via a safety valve.

When this situation arises hydraulic motor 23 is deactivated and actuators 24 and 25 are activated to advance plungers 26 and 27 until the bolts 26, 27 are disposed between the teeth 28.

At this stage hydraulic fluid is admitted to the cylinders 9 and 15 to push the piston 14 to the left as shown in Figure 2 and piston 8 to the right. The force tends to rotate the power tong 3 anti-clockwise. Since the bolts 26 and 27 hold the rotary 20 fast with the housing 19 the torque is applied to the rotary 20 and thence to the pipe (not shown) via the jaws 21. The cross-sectional area of the cylinders 9 and 15 is such that a substantial torque can be applied to the housing 19 to loosen even the most stubborn joints.

It will be appreciated that the bolts 26 and 27 should project fully into the space between the teeth. This can be assured in several ways, for example inspection ports could be provided in the housing 19 immediately above the free ends of the bolts 26 and 27. However, sensors 31, 32 are preferably provided which detect the position of the rotary 20 and prevent the actuators 24 and 25 being operated until position marks on the rotary 20 are aligned with the sensors 31, 32. As a further precaution, a position sensor (not shown) is also associated with each bolt 26, 27 and inhibits actuation of the piston and cylinders until the bolts 26, 27 are fully advanced.

Once the joint is loosened the bolts 26 and 27 can be withdrawn and the joint unscrewed using the hydraulic motor 23 rotating rotary 20 in the usual way. Cylinders 9 and 15 are also vented to atmosphere to allow the power tong 3 to float in the horizontal plane.

Various modifications to the arrangement disclosed

are currently envisaged. For example, the bolts 26 and 27 could simply be lowered through aligned holes in the top and bottom of the housing 19 and in the rotary 20.

Figure 3 shows an alternative double acting hydraulic piston and cylinder assembly. The assembly comprises a piston 8' which is mounted in a cylinder 9'. The cylinder 9' is divided into a hydraulic section 100 and a mechanical section 101.

The hydraulic section 100 is provided with ports 102, 103 for the admission and discharge of hydraulic fluid whilst the mechanical section 101 comprises cup springs 104, 104' disposed to either side of a piston 105 having a shaft 106 fast with an end fitting 107. The piston 106 has a short extension 108 which can engage a wall 109 separating the hydraulic section 100 from the mechanical section 101.

The piston 8' is connected to a shaft 110 which is fast with an end fitting 111.

In use end fitting 111 is pivotally connected to the power tong 3 whilst the other end fitting 107 is pivotally connected to support member 10. A similar double acting piston and cylinder assembly is used on the opposite side of the power tong 3.

In normal operation the hydraulic section 100 is kept full of hydraulic fluid. However, the passage of hydraulic fluid through ports 102 and 103 is prevented so that the piston 8' is effectively locked with respect to the cylinder 9'. However, the arrangement in the mechanical section 101 allows the power tong 3 to float in the horizontal plane.

When it is desired to use the hydraulic section 100 to turn the power tong 3 hydraulic fluid is admitted to the cylinder 9' through, for example port 103 and a corresponding volume of hydraulic fluid is exhausted through port 102. Thrust is applied to the power tong 3

- 7 -

via end fitting 111 and the reaction force urges the cylinder 9' to the right (as viewed in Figure 3) until the short extension 108 abuts the wall 109 whereafter the thrust is transmitted through piston 106 to end fitting 107.

The situation in the opposite double acting hydraulic piston and cylinder assembly complements the turning action. In particular, hydraulic fluid is admitted through port 102 and exhausted through port 103. The hydraulic fluid causes the cylinder 9' to move towards end fitting 111 until the hand 112 bears on the end wall 113 of the cylinder 9' via cup springs 104'. At this time end fitting 111 moves towards end fitting 107.

The two double acting hydraulic piston and cylinder assemblies produce a turning couple on the power tong 3.

At the end of a coupling/uncoupling operation the pressure at ports 102, 103 is allowed to equalize and further passage of hydraulic fluid through the ports 102, 103 is prevented by closing valves (not shown). The double acting hydraulic piston and cylinder assemblies are then in their normal position as shown in Figure 3 in which the hydraulic section 100 is effectively locked solid and the mechanical sections 101 of each assembly allows the power tong 3 to float in a generally horizontal plane.

A load cell 114 is incorporated in each assembly 114 adjacent end fitting 107 to check that the assemblies are in balance during a coupling/uncoupling operation.

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CLAIMS:

1. A power tong for releasing tight joints, which power tong comprises a housing (19) and a rotary (20) rotatably mounted therein, characterized in that said
5 power tong (3) further comprises means (26, 27) to inhibit relative rotation between said rotary (20) and said housing (19) and means (8, 9; 14, 15; 8', 9') to pivot said housing (19).
2. A power tong as claimed in Claim 1, characterized
10 in that said means comprises a bolt (26, 27).
3. A power tong as claimed in Claim 2, characterized in that said means comprises at least two bolts (26, 27).
4. A power tong as claimed in Claim 2 or 3, wherein at
15 least part of the circumference of said rotary (20) is provided with teeth (28) and said bolts (26, 27) can be advanced between said teeth (28).
5. A power tong as claimed in Claim 2, 3 or 4, wherein said bolt can be lowered through aligned openings in
20 said housing (19) and in said rotary (20).
6. A power tong as claimed in any preceding Claim, wherein said means for pivoting said housing (19) comprises a pair of piston and cylinders (8, 9; 14, 15; 8', 9') connected to opposite sides of said housing
25 (19).
7. A power tong as claimed in Claim 6, wherein said piston and cylinders (8, 19; 14, 15; 8', 9') are double acting piston and cylinders.
8. A power tong as claimed in Claim 7, wherein said
30 double acting piston and cylinders (8', 9') comprise an hydraulic section (100) and a mechanical section (101), and wherein said hydraulic section comprises a piston (8') connected to an end fitting (111) and disposed in a cylinder (9') between two ports (102, 103) for
35 permitting hydraulic fluid to flow to and from said

cylinder (9'), and wherein said mechanical section (101) comprises a piston (105) disposed in said cylinder (9') and connected to an opposite end fitting (107), said mechanical section (101) being separated from said hydraulic section (100) by a wall (109).

9. A power tong as claimed in Claim 8, including cup springs (104, 104') disposed to either side of said piston (105) in said mechanical section (101).

10. A power tong as claimed in any preceding Claim, wherein said means (8, 9; 14, 15; 8', 9') to pivot said housing (19) is provided with a load cell (114).

11. A bucking unit, characterized in that it comprises a back-up tong and a power tong as claimed in any preceding Claim.

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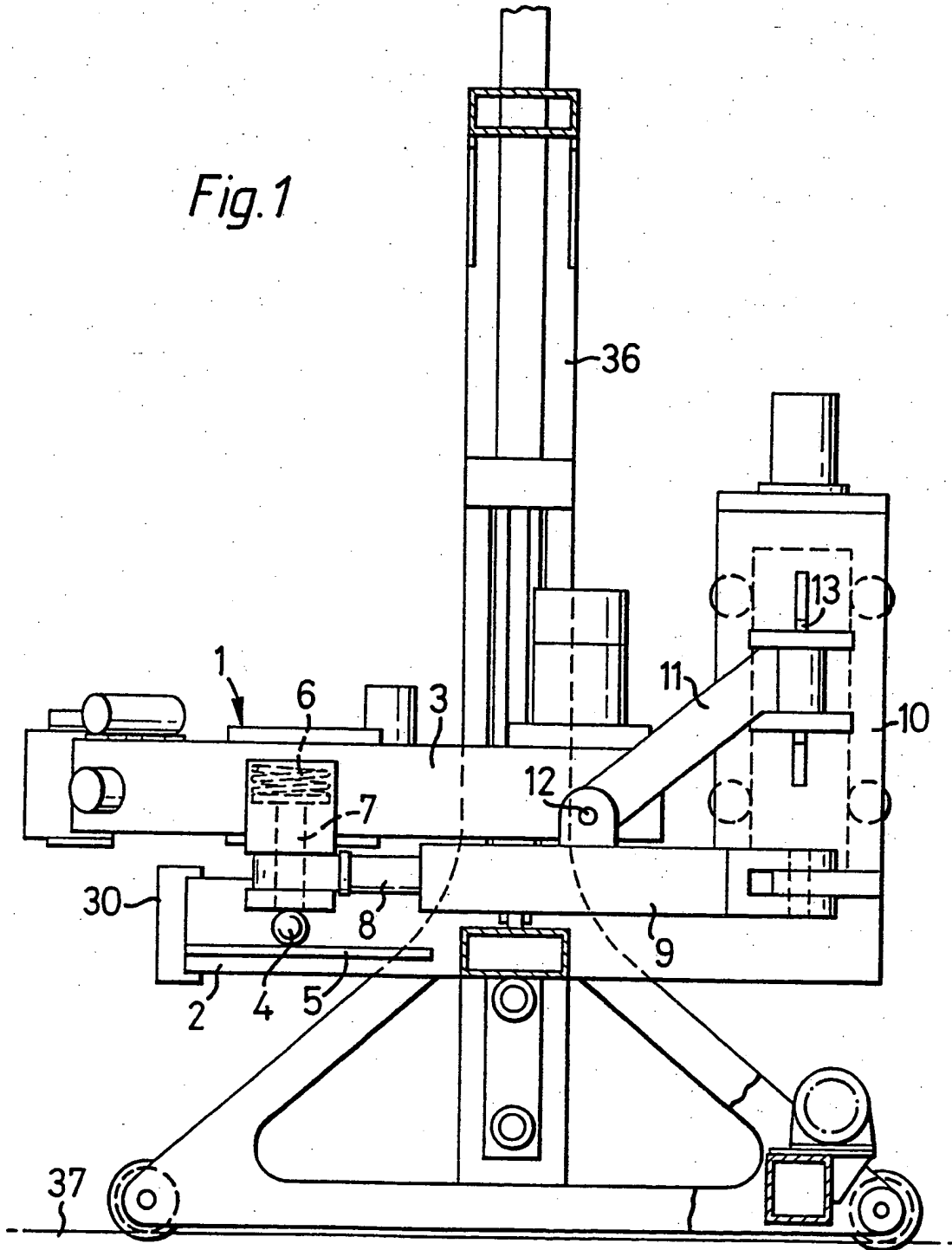
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Fig.1



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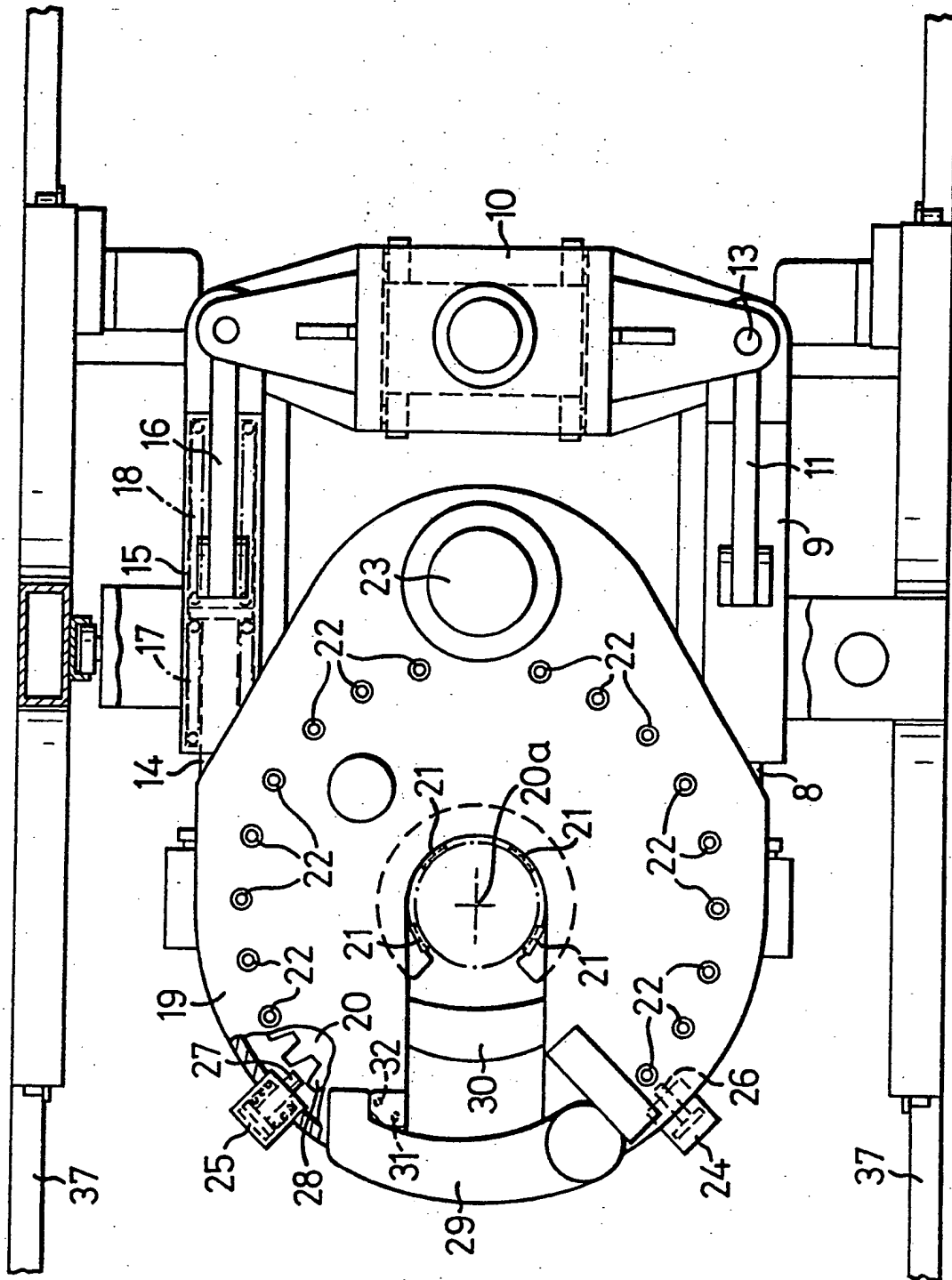
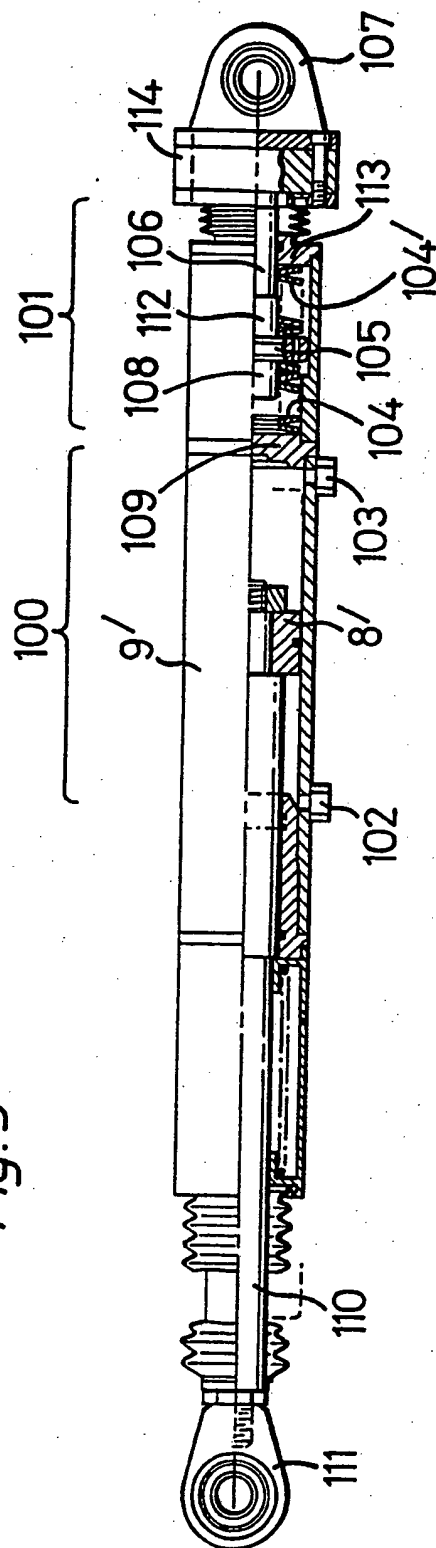


Fig. 2

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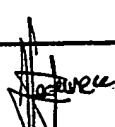
Fig. 3



INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 92/00647

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 E21B19/16		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	E21B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,4 574 664 (CURRY) 11 March 1986 see column 3, line 55 - column 6, line 25; figures 1-6 ----	1,6,11
A	US,A,4 334 444 (CARSTENSEN) 15 June 1982 see column 8, line 20 - line 33; figures 1,10,11 ----	1,2,5
A	GB,A,804 798 (JOY) 26 November 1958 see page 1, line 50 - line 65 ----	1,11
A	GB,A,981 569 (BORG-WARNER) 27 January 1965 see page 4, line 40 - page 5, line 52; figures 1-8 ----	1
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ON INTERNATIONAL PATENT APPLICATION NO.**

**EP 9200647
SA 57435**

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4574664	11-03-86	CA-A- 1231088	05-01-88
		DE-A- 3566568	05-01-89
		EP-A, B 0170195	05-02-86
		JP-A- 61044541	04-03-86
US-A-4334444	15-06-82	US-A- 4215602	05-08-80
GB-A-804798		None	
GB-A-981569		None	